

Bandsar, a creative traditional floodwater agriculture

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Abstract

Iranians have a very long history of water harvesting activities confronting water scarcity and frequent drought consequences. Among them, Bandsar is a wide spread indigenous knowledge which has been utilized in central and southern part of Khorasan province (North-East of Iran). Bandsar consists of a series of levees constructed subsequently along the contour lines and adjacent to seasonal streams so that flood water can be diverted from stream way and temporary stored in the levees' upstream. Water gradually penetrates into the soil profile and the accumulated moisture can be used for an appropriate cultivation. Bandsar agriculture found to be very unique and sustainable with regards to several key factors such as owners participation, land-use and water resource management. A field survey has been conducted in the suburbs of Sabzevar (57° 4'E, 36° 12'N) widely covered with Bandsars which have been used until the present time. Bandsar components, construction method, operation and maintenance have been studied and summarized here according to information gathered from field witnessing and face to face interview with some of the most experienced Bandsar owners.

Keywords: Bandsar, floodwater, runoff, agriculture

INTRODUCTION

Floodwater irrigation has been practiced in most of the arid and semi-arid zones of Iran and many other countries, which have similar arid and semi-arid climate (Ghoddousi, 1999). Among many kind of the methods used worldwide, Bandsar is the most specific type of floodwater harvesting which has been utilized in eastern part of the Iran (Arabkhedri and Kamali, 2008). Bandsar is composed of several earthen levees constructed successively along the ground contour line and next to a seasonal main stream from which the flood water can be diverted into the Bandsar via a conveying channel. The incoming water is spread behind the levees so that the resulting backwater causes the soil moisture to be increased enough to sustain compatible crops cultivated within the upstream side. Some types of Bandsars receive runoff water directly from a small upstream watershed provided that the possible peak discharge volumes will not endanger the Bandsar stability (Nazari Samani et al, 2014). Conveyance channels may no longer be needed and flood water will automatically flow down to, and get stored behind, levees with minimum care and efforts. Water in excess of Bandsar capacity is directed into the next part (i.e. next Band) from the end sides. Bandsar number and dimensions are selected according to the ground slope and floodwater harvesting potential. It is usually expected that a certain number of Bandsars can be filled up completely or partially depending on individual flood characteristics. Flooded areas would be plowed and cultivated where as dry Bands remain untouched for the following floods to happen. When the next flood occurs, experienced owners may be able to consider supplementary irrigation for those parts already irrigated. In general, stream flow hydrology and geomorphology would be very decisive for selecting Bandsar location mainly because a minimum of yearly flood water availability should be guaranteed.

CONSTRUCTION METHOD

Construction of Bandsar starts with visually benchmarking the levees and channel direction by the owners making use of supervision received from more experienced local farmers. The selected direction is plowed and loosen surface layer is dumped and compacted to form about a 1 m-high earthen levee. The conveying channel starts from one end of the Bandar's levee and is continued upward parallel to the main stream until they cross each other at the main stream bottom level. This would be the floodwater diversion point or conveying channel inlet. When the first flood occurs, the water is diverted from the main stream and flows along the conveying channel to be accumulated behind the Bandsar levees. At this stage, the owners start doing necessary modifications and manipulations with regards to levees and channel direction and structures. Locally available plants types are often cultivated along the interior toes of the conveying channel preventing any possible erosion. Compare to sandy soils, Bandsar dimension should be larger in clayey soil because of slow water penetration. Slope of the conveying channel should be considered so that it may not cause sedimentation or erosion along the channel bank. One larger channel is divided into smaller ones in order to convey water to the Bandsars located far from main stream.



Figure 1. Satellite Image of Bandsar location along a seasonal stream in the study area. Bright tone indicates sedimentation left behind the Bandsars (Arabkhedri, 2015).

OPERATION OF BANDSAR

Irrigation starts at the upper most Bandsar. Excess floodwater is diverted to the downstream Bands via levees end sides. Plowing and sowing starts as soon as the water has penetrated into the soil profile and appropriate equipment and machinery can move and work inside. A subsidiary wall divides Bandsar into parts for a minimum water level to be guaranteed in case that big flooding would not be happen. Because of the short flooding duration, most of the owners are prepared to be on their Bandsar site as soon as the weather is about to be rainy and flooding is expected. A bunch of weed and grasses are already

dumped at the diversion point to be used for controlling discharged into the conveying channel.

Selection of crop type depends on the time that the first flood occurs. If it comes on autumn, weed and barely may be the best whereas when the first rain and flooding occurs at winter time, Caraway and pea would be the better choice and eventually in case of spring flooding all kind of melon may be the most beneficial crop type. One should note that the rainy season in the Mediterranean regions (like Iran) starts late on late autumn (October) and ends on mid spring (April) with no rain in the rest of the year. Floodwater suspended load which settles down mainly within the Bandsar, includes very nutritious material so that neither animal nor chemical fertilizer may be needed (Ashouri, 2000). Bandsar soil, being too much fertile, makes it unsuitable for some sensitive crops such as wheat for example (but not Barly). (Figure 2)

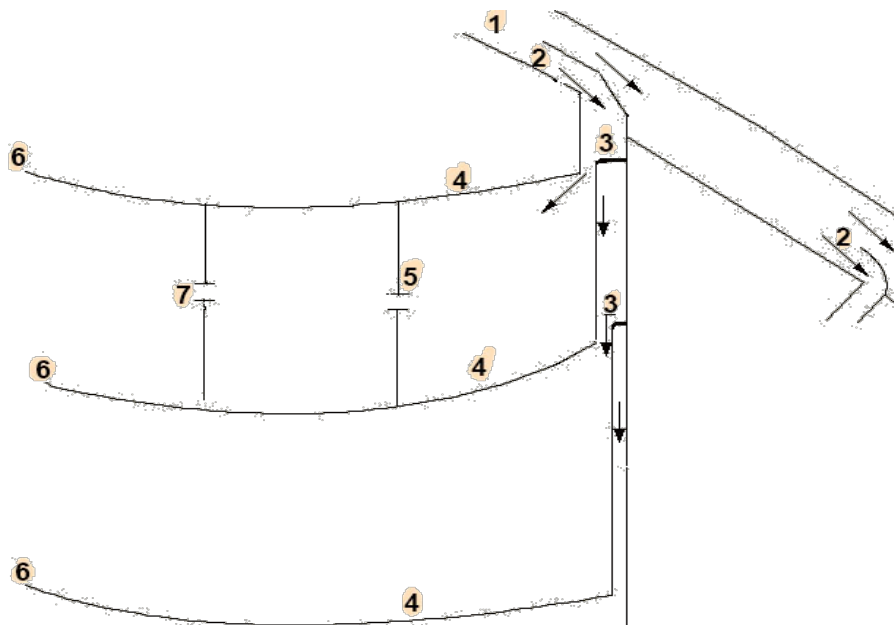


Figure 2. Bandsar component (1: main stream, 2: Bandsar inlet, 3: Conveying channel, 4: Levee, 5: subsidiary weir, 6: levee's end weir, 7: subsidiary wall (Arabkhhedri, 2015).

MAINTENANCE

As the bandsar are usually constructed manually, many breakages and holes as well as bank and bottom erosion and sedimentation may happen due to overtopping as well as animal activities. Therefore, Bandsars should be inspected and repaired carefully each year after rainy season. Accumulated sediments and unusual erosion wholes should be leveled for the sake of the most uniform water distribution within the Bandsar. Animal holes and wall breaks should be blocked and re-compacted. Making use of fine grained sediments transported to the Bandsar, The owners usually spend some time and effort improving levees' stability and increasing Bandsar capacity. Very fine grained transported soil is sometimes carried away from Bandsar to be used as impervious material for construction purposes.

ECONOMY OF BANDSAR

Using Bandsar, crop yield can be increased considerably compared to dryland agriculture because of prolonged soil moisture availability. Regardless from the initial investment for construction of Bandsar, the cost of operation and maintenance is very negligible whereas the incomes have been very competitive with conventionally-irrigated agriculture. This is in spite of the fact that the Bandsar agriculture may experience short and long time drought periods during the time. This is mainly because the good years' incomes usually compensate the failures that happen during drought periods (Rahi et al, 2007).

THREATS AND SHORTCOMINGS

Bandsar agriculture is threatened by the following problems:

- Climate change-caused severe irregularities in receiving floodwater in terms of magnitude, duration and frequencies.
- Original owners are getting old and new generation does not like to follow their parents' jobs.
- Bandsar owners mostly living in villages are gradually immigrating into the large town and cities looking for higher living standards and incomes.
- Increasing sand and gravel production from corresponding flood streams have caused depletion of stream beds so that water diversion may no longer be affordable.

COUNTER MEASURE

Government should seriously support Bandsar agriculture by allocating appropriate incentives for the owners as well as establishing supportive legislation to prevent depredation of the areas with Bandsar concentration.

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